Questions for Broadband Deployment Projects

(July 17, 2025)

Each broadband deployment project submission should answer the questions relevant to the broadband technology or technologies to be deployed in a project area. Please include the question identifier and heading, such as “QD: Logical network diagram” to ease evaluation. There is no need to repeat the instructions.

Some questions need to be answered only if you want your project to be considered as a priority broadband project and are labeled accordingly. Similarly, only projects aiming to be granted points for the secondary criteria need to answer questions about network resiliency and scalability. OSB will not attempt to guess project capabilities from other information.

This addendum provides additional details to the sections labeled “Backhaul and Network Architecture” and “Technical Capability” in Section 1 of the project narrative (proposal), as described on pages 13 and 14 of the Maryland *Subgrantee Selection Application Guide* and answers should be included in that section of the proposal.

In each case, describe current capabilities, i.e., those being deployed as of July 2025, as well as the capabilities that will be deployed for any funded BEAD projects within the build-out period, if different. For performance metrics, cite the source of information, e.g., third-party evaluations, manufacturer data, or measurements conducted inhouse. If technologies are to be deployed that are not currently commercially available, please describe how you arrived at the description of the capabilities, e.g., measurements of lab prototypes or manufacturer assurances. If appropriate, indicate any related technology maturity risks, e.g., if you rely on claims of future capabilities by manufacturers or on technology, spectrum, or infrastructure that requires regulatory approval that has not been granted yet.

Any performance-related questions should be answered based on measurements or tests for the state of Maryland or the county the project is in, not nationwide results. If the applicant is not currently operating a network in the state of Maryland, results for states with a similar topography and population density may be used; the applicant needs to justify their choice of an alternative geographic area.

If this document applies to several counties or project areas, you can upload a single sheet that references the generic description (e.g., “See answers submitted for Kent-1”).

I. General Questions (All Technologies)

The questions below apply to all technologies, but the answer is likely to depend on the network technology.

A. QD: Logical network diagram

For FTTP: Provide a logical diagram showing backhaul between the Internet and central office (CO) / headend location(s); active optical distribution network components (i.e. Optical Line Terminals, or OLTs); passive optical components, including splitters (if applicable); and customer premises equipment (CPE), including the optical network unit (ONU) and/or customer gateway device.

For LEO: Provide a logical diagram showing terrestrial backhaul, terrestrial gateways, gateway to satellite uplink and downlink, inter-satellite connectivity, and satellite to CPE pathways.

For HFC: Provide a logical diagram showing backhaul; headend systems, including cable modem termination system (CMTS); fiber nodes and links; active distribution network components (amplifiers, taps, etc.); and customer premises equipment (CPE), including the cable modem or customer gateway device.

For FW: Provide a logical diagram showing backhaul connection between the Internet and provider demarcation; provider-operated backbone fiber or wireless network to base station site(s); towers/vertical structures; radio access network (RAN); frequency bands and channels used; example premises installation(s) (vertical structure where applicable, connection from antenna to CPE, connection from CPE to user equipment).

B. QR: Performance and Reliability

QR1: How does the applicant monitor and ensure that roundtrip latency, real-time packet loss, and jitter remain within the following thresholds during typical and peak operating conditions?

> Latency: ≤ 100 ms; packet loss: ≤ 2% over any 15-second interval; jitter: ≤ 30 ms over any 15-second interval.

QR2: What mechanisms are in place to detect and mitigate congestion?

QR3: How is network congestion detected in real time?

QR4: What mechanisms are used to prioritize or shape traffic during periods of congestion?

QR5: What is the total average network outage subscribers experienced last year? Does the applicant track and report outages?

> BEAD NOFO: "Each Funded Network's outages should not exceed, on average, 48 hours over any 365-day period except in the case of natural disasters or other force majeure occurrence." An outage occurs if a significant fraction of the internet is not reachable by subscribers, including due to failures in supporting infrastructure such as DNS resolvers or DHCP servers.

C. QC: Performance Calculation

QC1: Using worst-case design assumptions, please provide calculations demonstrating that the network can provide to each location at the time of activation: (1) a minimum of 100 Mbps download and 20 Mbps upload; (2) ≤ 100 ms roundtrip latency; (3) simultaneous 5 Mbps to all connected locations, including BEAD and non-BEAD users.

> Describe any shared network elements and how they are dimensioned to meet the capacity requirement. For LEO: Your calculations must account for total spectrum usage within the beam(s) serving the proposed project area as well as total spectrum usage and capacity between the satellite(s) and terrestrial gateway(s).

II. Priority Broadband Project Questions (All Technologies)

The questions below apply only to projects the applicant wishes to be considered as a priority broadband project.

QP1: Explain how the network can scale to provide service to all eligible locations, whether designated as business, residential, or both (X), to a download speed of 250 Mbps and an upload speed of 50 Mbps within five years after initial deployment.

> If the proposed technology already provides this level of service, provide evidence (such as existing service plans).

QP2: Explain how your network architecture provides capacity for all connected users within the project area, whether funded through BEAD or not, must be no lower than 12 Mbps for each subscriber.

> For many networks, middle mile connectivity may be the limiting factor. Explain how you can scale up middle mile capacity as needed.

QP3: Explain that you can offer service to all CAIs in the project area at a speed of at least 1 Gbps symmetric.

For example, you may cite experience providing such service in other areas in Maryland.

QP4: Explain how cell sites in your project area, both existing and likely additions (e.g., rooftop, or water tower locations) can be offered service at 1 Gbps symmetric and must support a latency of 1 ms.

A latency of no more than 1 ms is required to enable Ultra Reliable and Low Latency (URRL) communications, a key differentiator of 5G and 6G service. Latency here is measured to the carrier customer (e.g., mobile service provider), not an IXP. You may cite any provisioned cell site backhaul that you are providing in Maryland or states with similar population density and topography.

III. Scalability Questions (All Technologies)

All questions should be answered based on technology and capabilities available at the end of the deployment to **all** BEAD-supported locations, both residential and business, in the project area, within the usual ten-day installation window and without special installation fees.

QS1: What is the highest download speed that will be available to subscribers?

QS2: What is the highest upload speed that will be available to subscribers?

QS3: What is the lowest round-trip latency that will be available to subscribers?

Latency is measured according to the FCC/USAC requirements[1].

QS4: *Do these speed and latency values rely on technology or products that are not currently commercially available? Which?*

Describe the technology and its availability, and your approach to mitigating technology risks.

[1] see https://www.usac.org/high-cost/annual-requirements/performance-measures-testing/

IV. Resiliency Questions (All Technologies)

You only need to answer these questions if you want your proposal to receive secondary scoring points in the resiliency category.

QR1: Describe power backup for all network elements, excluding CPE, necessary to connect subscribers to the internet.

QR2: How many hours can network elements function after loss of utility power?

> If this differs among types of network elements, describe. For example, if HFC amplifiers have no backup power, any loss of utility power will prevent internet access, even if data centers hosting backbone routers can sustain operations indefinitely.

QR3: What fraction of your last-mile fiber infrastructure in the project area will be buried?

> Estimates accurate within 10% (e.g., "45% will be buried" covers projected fractions from 35 to 55%) are sufficient. For technologies using wireless technology to connect CPE, such as fixed wireless and satellite, consider the fiber backhaul to transmitter sites or ground stations.

QR4: Do you have redundant middle-mile connectivity to your IXPs?

V. Coaxial Cable / HFC (Technology Code 40)

A. Access Layer

QHA1: What is the total upstream and downstream DOCSIS channel capacity allocated per service group?

QHA2: What is the average or nominal number of serviceable passings per fiber node by design?

QHA3: What is the maximum number of serviceable passings per fiber node by design?

QHA4: How many anticipated subscribers will be served per fiber node upon activation?

QHA5: What is the DOCSIS version currently deployed

QHA6: Describe how your CMTS is configured for node segmentation and combining in both the upstream and downstream directions.

B. Headend & Internet Backbone Connectivity

QHH1: Describe the capacity of all links between the CMTS and the Internet backbone, including the uplinks to backbone routers and the connections to both transit and non-transit peers.

QHH2: Describe the physical and logical redundancy of the proposed network, including CMTS components, backbone network devices, and core routers and backbone transport links.

VI. Fiber to the Premises (Technology Code 50)

A. Access Layer

QFA1: Describe the access layer FTTP technology that will be used (e.g., GPON, XGS-PON, Active Ethernet).

Include the reasoning for this selection based on the density and characteristics of the project area.

QFA2: Describe the OLT configuration, including the number of PON segments per chassis and how the segments are distributed across the chassis.

QFA3: Describe the proposed PON size, including the maximum split ratio, the number of serviceable passings per PON, and the anticipated number of subscribers per OLT port at service activation.

B. Headend and Internet Connectivity

QFH1: Describe the capacity of all links between the OLT(s) and the Internet, including the uplinks to backbone routers and the connections to both transit and non-transit peers.

VII. Low-Earth Orbit (LEO) Satellite Service Questions (Technology Code 61)

A. Access Layer

QLA1: What is the downlink channel size (in MHz) per beam?

QLA2: What is the uplink channel size (in MHz) per beam?

QLA3: What modulation and coding schemes are used for uplink and downlink transmissions?

QLA4: What are the typical and peak spectral efficiency values (bps/Hz) achieved with these schemes?

QLA5: What are the minimum receive sensitivities or required SNR values (in dB) for each supported modulation and coding level?

QLA6: What is the fade margin (in dB) available for both uplink and downlink paths under worst-case conditions (e.g., heavy rain, atmospheric attenuation)? If more than one type of CPE is offered, provide fade margin values for each type.

QLA7: How many beams are generated per satellite?

QLA8: What is the physical footprint (diameter in km) and shape of each beam at the Earth's surface?

QLA9: What is the approximate physical separation (in km) between adjacent beams?

QLA10: What is the frequency reuse pattern?

QLA11: How is co-channel interference mitigated between reused beams?

QLA12: What is the estimated worst-case number of active users per beam, accounting for BEAD-funded users as well as other LEO subscribers in the coverage area?

QLA13: Describe how the system selects or switches satellite connections for a CPE. For example, does the CPE connect to the satellite with the strongest signal, does the CPE maintain connections to multiple satellites simultaneously, is beam or satellite assignment managed by the network based on congestion, satellite pass duration, or other optimization criteria?

QLA14: Please provide a statistical distribution of the number of satellites in view of the proposed Broadband Serviceable Locations (BSLs) over time. Include a table or chart

showing the percentage of time that 1, 2, 3, or more satellites are simultaneously visible from a typical BSL in the proposed service area.

B. CPE

QLC1: What spectrum is used for the link between the CPE and the satellite, and what is the link capacity?

QLC2: What type of connection does the CPE provide to end-user devices at the premises (e.g., Ethernet, Wi-Fi), and what is its maximum supported throughput?

QLC3: Does the proposed service include professional installation?

QLC4: Will the provider install the service on rooftops or other elevated locations if necessary to obtain an unobstructed view of the sky?

QLC5: What is the minimum area of unobstructed sky view required at a customer location for reliable service?

QLC6: What is the expected impact on performance (e.g., throughput, latency, packet loss, connection stability) if the sky view is partially obstructed?

QLC7: What is the estimated frequency and duration of service interruptions or performance degradation over a 24-hour period if 10% of the required sky view is obstructed?

QLC8: What is the estimated frequency and duration of service interruptions or performance degradation over a 24-hour period if 50% of the required sky view is obstructed?

QLC9: What percentage of locations in the proposed project area are expected to lack sufficient unobstructed sky view due to terrain, foliage, or buildings, and how does the applicant plan to serve these locations?

QLC10: How has the applicant qualified the locations included in the list of locations?

> For example, does the applicant use a tool that estimates the available sky view based on topography, foliage, and shading by other buildings? Does the tool assume a maximum feasible antenna elevation? Does the antenna height take into account local building codes and zoning ordinances?

C. Gateway Infrastructure

QLG1: How are gateway sites selected and constructed to manage the effects of local weather, foliage, terrain, and radio frequency interference?

QLG2: What operational or design measures are taken to ensure resiliency and consistent link quality under adverse conditions?

QLG3: Describe the upstream and downstream terrestrial backhaul used to connect gateway sites to the internet backbone and data centers.

QLG4: What is the current capacity of these backhaul connections?

QLG5: How is capacity scaled over time as demand increases?

QLG6: What is the typical downlink and uplink channel size per gateway-to-satellite link?

QLG7: What modulation and coding schemes are used for these links, and what is the resulting spectral efficiency?

QLG8: What are the receive sensitivity and minimum SNR requirements for each supported data rate and modulation/coding level?

QLG9: What fade margin is maintained on uplink and downlink transmissions to mitigate signal degradation due to rain, humidity, and other atmospheric conditions?

QLG10: What is the aggregate throughput capacity from a single gateway site to the satellite constellation?

QLG11: How many satellites can a single gateway maintain simultaneous connections with?

QLG12: Is the same frequency spectrum reused for multiple gateway-to-satellite links? If so, describe the reuse strategy and any limitations.

QLG13: How many gateway stations will be serving the BEAD and non-BEAD subscribers in Maryland?

D. Reliability and Quality of Service

QLR1: How does the system mitigate packet loss or disruption during handoffs between satellites?

QLR2: In a worst-case scenario, what is the measured duration of MAC-layer link loss during a satellite handoff?

QLR3: What is the impact of satellite handoff on end-to-end latency, including any mitigation techniques?

QLR4: What is the expected instantaneous packet loss (in % or packet count) during satellite handoff or gateway reassignment?

QLR5: What evidence does the applicant have that users do not experience disruptions in service during real-time audio and video calls, such as VoIP or video conferencing?

VIII. Terrestrial Fixed Wireless (Technology Code 70, 71 and 72)

A. Radio Access Network

QWR1: What is the maximum downlink user throughput?

QWR2: What is the maximum coverage distance where the RAN reliably achieves the BEAD performance requirements?

Consider the terrain found in Maryland, including hills and forested areas.

QWR3: How many fixed wireless subscribers share the same transmitter (sector), at most?

QWR4: For ULFW or CBRS: Who manufactures the radio access network equipment?

QWR5: For ULFW or CBRS GAA: Describe the effects of sharing the spectrum with other users on system capacity.

*QWR6: Describe the spectrum bands to be used **for the project area**, including the license status (e.g., PAL or GAA for CBRS).*

QWR7: Is the RAN shared with mobile users? If so, how will you ensure that all interested BEAD locations can obtain service and achieve the BEAD performance requirements for the duration of the federal interest period?

Describe how tower coverage areas or sectors of your current radio access network network are opened and closed to new fixed wireless subscribers. Do you assume a maximum take rate for the project areas?

B. Tower Sites

QWT1: For each tower site currently used or planned, provide:

- site name,
- latitude,
- longitude,
- elevation,
- address,
- structure type (e.g., monopole, guyed tower, rooftop),
- whether in service or planned,
- whether the applicant owns or leases the whole tower facility or leases vertical space,

- backhaul technology (e.g., fiber or microwave),
- backhaul capacity in Mbps,
- number of sectors,
- number of potential BEAD and non-BEAD fixed wireless subscribers for each sector.

C. CPE

QWC1: Does the proposed service include professional installation?

QWC2: Will the provider install the service on rooftops or other elevated locations if necessary to achieve the necessary signal strength and, if applicable, line-of-sight to the base station?

QWC3: How has the applicant qualified the locations included in the list of locations?

For example, does the applicant use a tool that estimates the link budget based on topography, foliage, and shading by other buildings? Does the tool assume a maximum feasible antenna elevation? Does the antenna height take into account local building codes and zoning ordinances?